Biometrics

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Lecture no. # 21

CS698X

Multimodal Biometrics Projects

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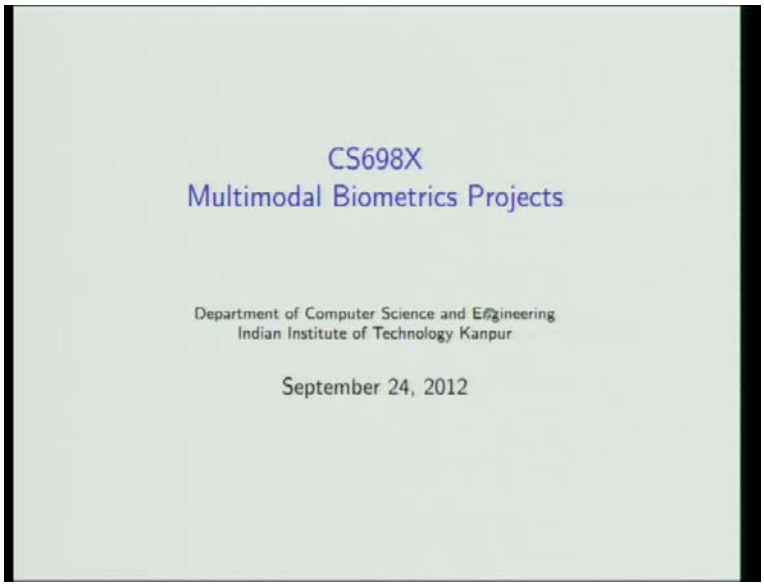

I am giving a brief idea about some of the projects that we will be offering.

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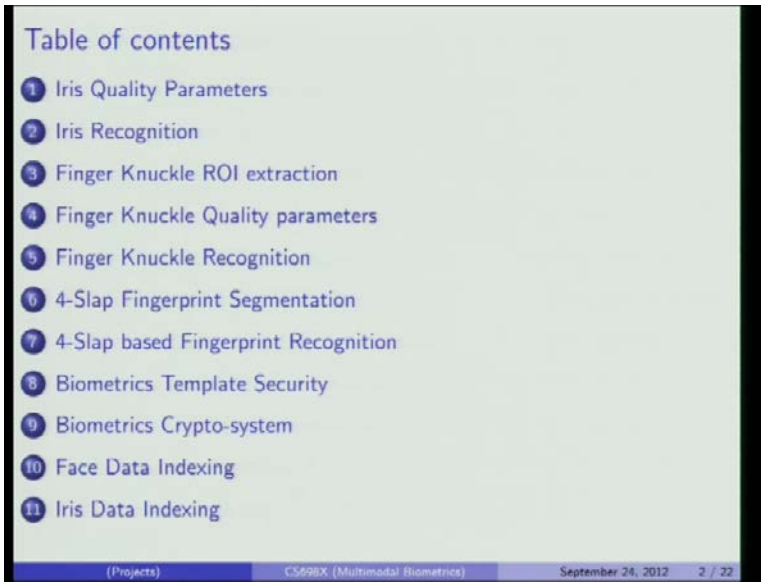

This is the list in which starting with the iris. So, some of the quality parameters by which, we can estimate the quality of a given iris image, then this is the recognition.

So, as I have said that those, for every project there will be one mentor assigned to you also. So, right now I am giving a brief introduction about this problem that, what is the problem, what type of databases on to which you will be working, what is the input, and what is the output that we usually require; and then, about the about the pin pointed techniques and all means once you got interested, you can meet in the allotted this this student, PhD student, he will help you.

The second one is the iris recognition, I will be telling you about it, then, this is the new trade that is our finger knuckle, I will be showing you some of the images about it. So, in the first problem about it is that, the given the image, how one can extract the ROI, the Region Of Interest that we wanted.

Then again, same as our the quality parameters, because you know that, if if we somehow can estimate the quality of a given image, it is very useful because this quality is directly proportional to the proportion that, how well it is going to be matched; if the quality is bad, it is not going to matched. So, one can see that, this quality of a given image that we use to acquire of the same person, it is going to vary and third one, basically we want the knuckle recognition, so third one is the recognition.

Then is our fourth slap, so it is again a new thing you will be seeing that what is fourth slapped fingerprint looks like, and given a fourth slap, we wanted the segmented four fingers out of it. So, that is the fourth slap segmentation and then using that, we want the fourth slap recognition. So, in the recognition also, one can see that given the four different fingers of a same person, we match with four of them, fuse their score in such a way so that we get the better results.

So, it is slightly different from the single fingerprint recognition, although the once given a single fingerprint, we match using a single fingerprint algorithm, but we have to fuse the result in such a way and you know that, the quality of these four finger, the best quality one is the first and the second finger and this, the quality is not that much good. So, all these things I mean should have to be taken care when you are fusing the scores, and these two are the basically related to the biometric template, basically the security of the, our biometric traits, template security and the biometric crypto systems. So, Kamalesh you will tell about them and this is the index.

So, given a when you are working on a huge amount of database and you wanted to match. So, suppose that you have x images, so how many matching you have? You will have x square matching exhaustively. Exhaustively if you wanted to find out a match, but somehow, so it is a very big number, x it is it is a square, so it is a very big number. So, indexing help us to do, we we do some sort of pre processing, we saved them and then when you wanted to match a single image, we need not to match with the whole database, they will be a some small amount of images on to which we simply match that, and we finally got the result, so indexing will help to do this thing.

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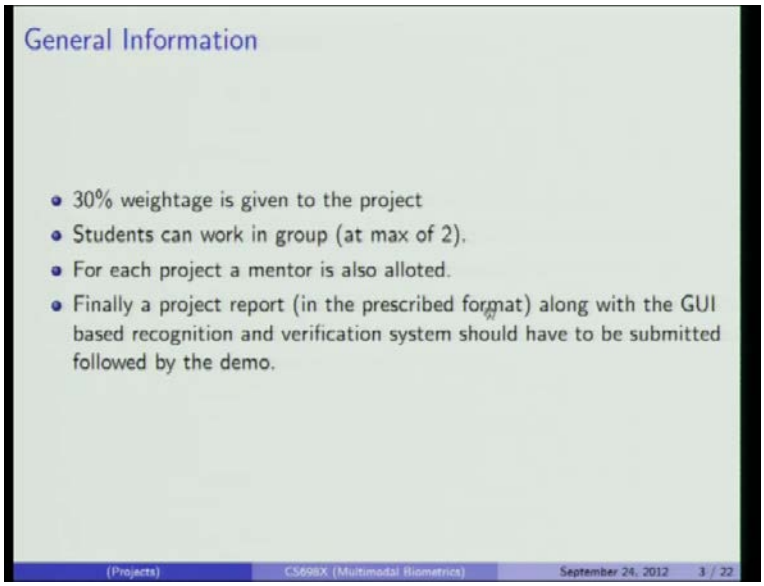

So, starting with the, there is a general 30 percentage weightage is given at max 2 students can mentor will be allowed and finally, we will have to submit a project report along with the GUI based the recognition and the verification system, wherever it is required, sometimes you will be requiring the, you you will be calculating the quality. So, you will be given a image, you will be printing the, what are the quality attribute and the quality final quality score, and you will have to give a demo also.

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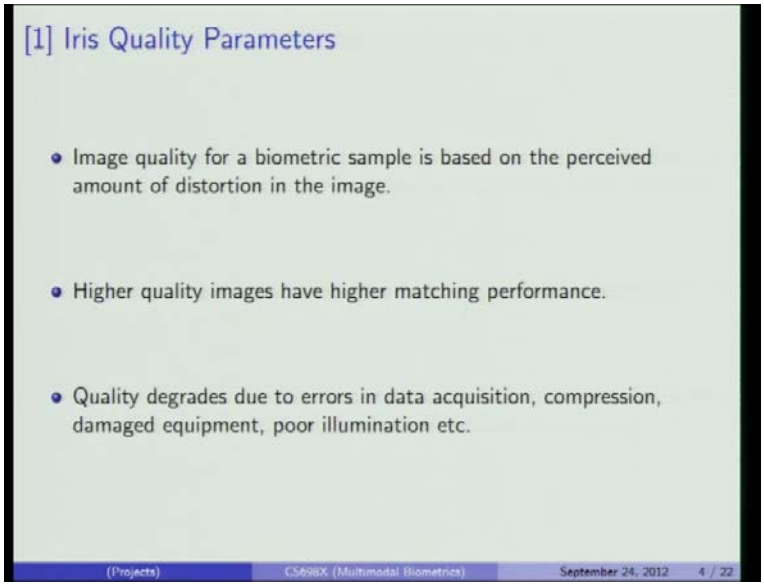

So, suddenly the quality parameters, so as I have said that, the higher the quality and the matching performance increments increases with that and you can see that, the for the given iris image, the quality degree as due to the error when you are capturing the data at that time, because of some errors, because of the compression you can know, you you see that, because of the compression there will be some error, damaged equipments. It is specially I mean, suppose that you are working on a camera and there is some mark or something, some dust which is on the lens and because of which you are getting some bad quality images.

Illumination, it is a most important thing, the poor illumination, sometimes you see that the light is not properly falling on the eye because of which you are not getting the good quality of images.

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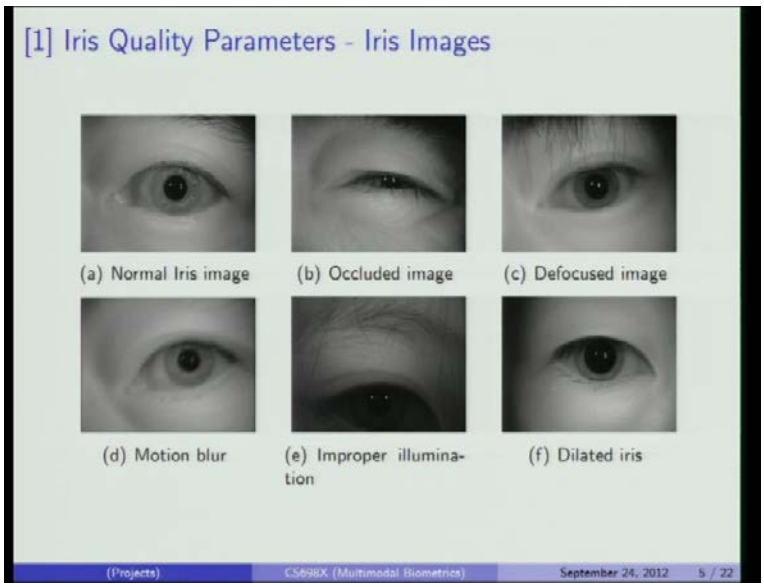

But, usually one can see that given a iris image, these are the different iris images, here you can see there is a normal iris, but this is an occluded iris. Now, here one can see that the, if you see that you directly use the parameters of any algorithm by which you can say that the quality of this image as a whole; the the quality of a image and the quality of an iris image, both of these things are different, may be you can say that it is having a good sharp edges. So, you can say that the the image is very good, but here if you can see that the the edges are very sharp, you are getting most of the things, brightness is fine, illumination is fine, but there it is occluded.

Now, this is something which is exactly related to the iris itself. If it is not an iris, if it is a face image, you would not be that much bothered about, you say that you are getting the full face, you are getting the nice edges, properly illuminated, but here because it is occluded. So, this is something, this is the parameter which is going to affect the quality of the iris, this is the thing. So, out of all of those parameters which we used to see, when we used to say that this image is better than that image, one can say that this image is better than this image, why you are saying this, because now you have seen that it is occluded. So, this is the thing that, we actually want, how can we quantize that, how much it is occluded.

Similarly, this is a defocused image, you can see that the image is not properly focused. Here you can say that, because in the case of iris also, what happened that our eye use to move very fast. So, when you are capturing this image, what happen that, because of some motion blur, you are getting this sort of image, improper illumination and here it it is a dilated iris. So, you know you know that when you are capturing an iris and you are placing some light source in front of it, what happen that eye use to dilate a bit, because of that light. And what is happening, you can see that here, the iris portion is bigger here, the iris portion is not that much bigger.

Here you can say that, this is a perfect ideal ideal iris image that we want. So, these are all some of the abnormalities that we used to see in the iris image. So, the thing is that, we wanted to find out automatically of course, that given this sort of image, I wanted to know that, what is the amount of occlusion that is there in this image, what is amount of defocused, what is the amount of illumination, what is the amount of motion blur, or the how much it is dilated.

If we calculate these all, these things, then we can say that these are the attributes which are related related to this particular iris.

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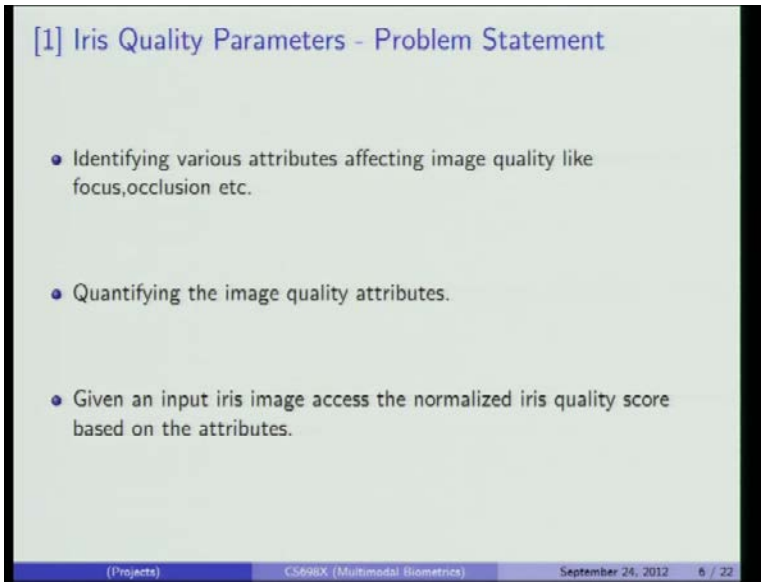

And yes of course, what is required then is that, we have to identify these different attributes, and then quantify this quality attributes, it has to find out what is the value. And then using those values, you have to find out the complete normalized iris score, you have to fuse all of these parameters in such a way so that you are going to get a normalized iris score which is based on this attributes.

(())

Go back to your image, see what happen then, you are expecting that cause you will be or ROI is there.

Yeah.

And from that iris sepia

Yeah.

First is then rectify your sepia or correct your.

Yes yes that that can also be a parameter so.

Included

Yeah, yes.

And then amount of occlusion.

Yes.

Amount of noise like also

Yes yes.

Parameters

Yes yes.

Right.

So, I wish yeah I

This amount you want to add them.

Yes.

To get a low point

Yes.

Am I right?

Yes yes

I will be showing you that, so given we use to get images like this, but what we have to find, we have, so there is a different phase in which we do the segmentation. We find out this circle and this circle. It is a basically a donate…

(())

Yeah, that we will be providing, mainly basically providing you this image and also I will be showing you the segmented and the normalized images.

So, you will be getting all of these images, you need not to do the segmentation, you need not to do the normalization, all of them will be given, you simply have to find out that given this image and this set of images, what is the the value that we want, which is by which we can assess the quality of the image.

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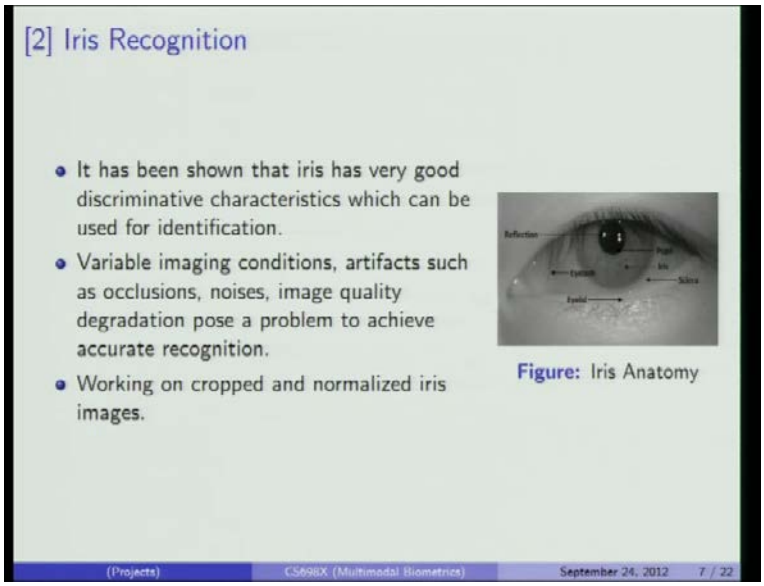

I am going on to the recognition, so as I have told that, the once you know the quality. So, recognition the best algorithm, I mean the iris is the best trait, it used to give us the better, the best results as far as the accuracy is being concerned, and because it is have it have a huge amount of random texture within it.

So, several things one can see here which is not properly visible, some eyelashes, eyelid, this is basically the donate portion that I have shown you, the donate portion, the black region and the the outer white region; in between this, the the portion that is actually called as the iris. We wanted to segment that thing out of it and then once you got the donate portion out, then we segment, then we normalized it in our strip, it is a rectangular strip and then we will be working on that is strip. So, basically those who will be working on the recognition directly provided the cropped, normalized iris images.

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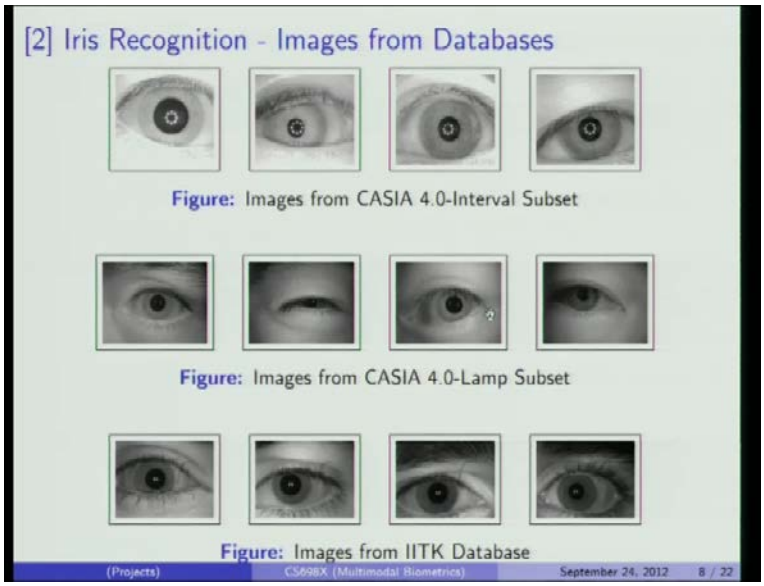

And you will be working on this itself, these are some of the images I have shown some, so these are the three databases on to which we will working on, This is the cassia, interval cassia, lamp and this is the IITK database, this is our own database.

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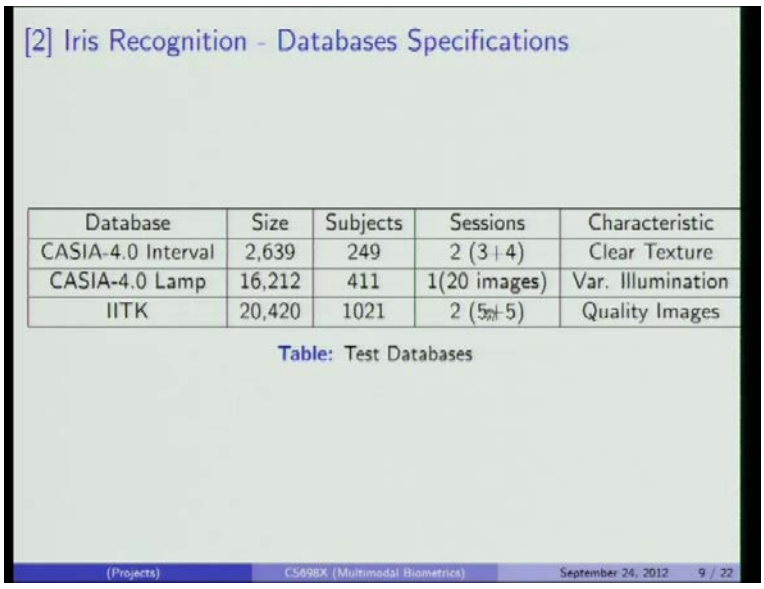

This is the size of the databases. So, interval it basically consists of 249 subjects, lamps having 411 subjects and IITK is having 1000, more than 1000 subjects. Session means that, the images that are acquired, they are acquired in two sessions. In the first session, they have acquired 3 images and next session, they have acquired 4 images. The

characteristics like that, it is having the the, cassia interval images are very good images having a very clear texture, it is lamp. So, it means that the, these images are taken with lighting up a lamp and without lighting up a lamp, that is why it is having a variation, the illumination.

So, they wanted to see that, how much variation it is there, because of the illumination. So, first it is having 20 images. First ten images are with lamp and next ten images are without lamp, but it is in the single session, I mean session means that, first you take first image, first set of images, then you wait for say some 10 days, 15 days, sometimes 3 months, 4 months and after that, you are taking the images.

Here, they have taken it in a one go, 20 images, first ten images are illuminated, next ten images are not illuminated. And here in our case, IITK database, the huge amount of images that we have also taken a 2 sessions and 5 in one session and next 5 in the second session and the quality of the images fine, it is having good quality images.

So, does it mean that I take the IITK (()) images?

No.

As the base image

Yes, yes.

And with respect, I I want to tell my student is very good.

Yes.

So, what does it mean with respect to 1?

Yes, so that is what see, we use to say wanted say is that, suppose it is trying to work, find out some of the quality parameters. So, once you got this algorithms by which you are estimating the occlusion, you are estimating the motion blur, you are estimating several different parameters. So, what you do that, given this good quality images, you find out this parameters and then you can use different classifiers, because now you have a huge amount of images which are good.

So, what are the parameters by which, by the virtue of which they are characterized as the good images, those parameters you have. Now, using those parameters, you can give it to as different other classifiers by which you can point out, you can construct your own, this classifier by which you are saying that its having quality 1, 2, 3, 4 and 5, good or bad depending upon the, so by you can use these images as a good quality images.

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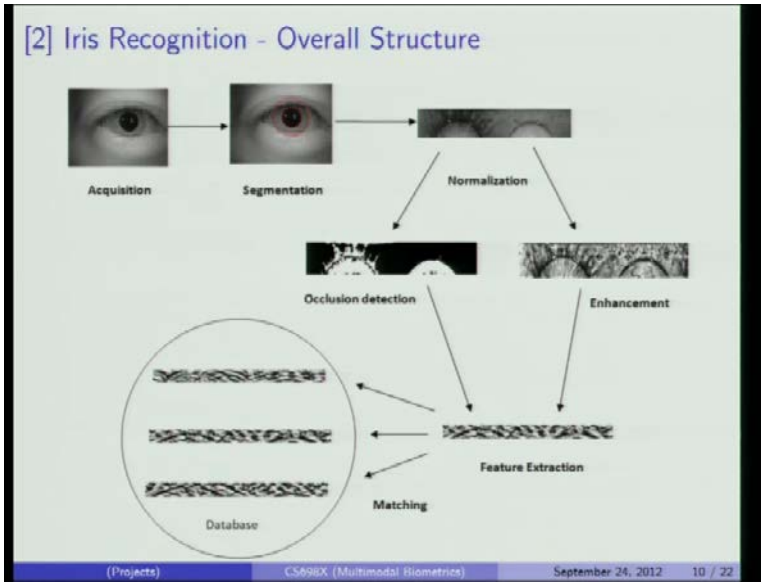

And this is the overall structure, so this is the acquisition, this is the segmentation, and this is the normalization. So, as I have told you that for recognition, for anyone I mean, you does not have to do this thing all, this is itself is a very complicated problem, given this image you wanted to find out the circle. Now, you can see that red, this is the donor that we actually want. Once you got this donor, from here you have to find out this normalized image. Now, this is basically in Cartesian coordinate; from here, if you convert it into the polar coordinate, then you will be getting a rectangular strip that is the thing, up to this you will be getting, even if you want then you can get also this, this enhancement.

So, from here you will have to different feature extraction and different. So, once you got the the enhanced image from which you can get the feature extraction, these features are extracted and they are matched with the features that we have in our database, and the one with which it is matching. Most it is said that, this this person is that person in this way, we use to decide the particular matching.

(())

Yeah.

(()) credit the class.

Yeah, yes.

So, is there a database from where, from which we have to validate as in R D is 1021 images.

Yeah.

Classified only

No, no no they are not, sir, first of all these are subjects, images are 20000. So, images they are not classified, you will have to classify.

So, how do we validate data, classification is valid or not?

So, see on the test, so given say 20000 images, you some somehow take some 500 images which are occluded, you know. And then out of that, you work on say 250 and other 250 for the testing, in this we use we use to what ultimate goal of this quality quality thing is that, once you feel and you see that your algorithm is working well, and you are saying that the quality of this image is good.

Now, how we justify, we need not to justify that whether it is properly occluded or not. The thing is that, it should be matched properly and how it is matched, it is it should be matched using the recognition algorithm. So, if you are saying that the quality of this quality of this image is good, first thing is that visually you can also justify that thing that why it is good, because it is having lots of occlusion, it is having less motion blur, it is having this thing and that thing, it is having good amount of illumination, sharp edges, several things.

If you can justify it, then it means that your thing is working well. Second thing is that, how automatically or some graph which can show you. So, it means that, if you are working on good quality images, you will be having better accuracies; the accurate full ROC graphs will be lower towards the axis.

(())What is my question is, I just remember out of the 20000 images what I can tell you out of 20000 images most of them are that is under control environment and we have collected the data, so whatever their eyes are open but I want to know that whether 20000 images are we can occluded or not.

No.

No no, it is not there.

See for example, you need to have to take down right. So, that way you have to think little and in the case of occlusion the, here occlusion another thing, there also you find too many (()).

So, it is just like that, suppose given this normalized thing, Sir is saying that, you can divide into different block and then you know that, because if if it is occluded it will be having more black thing or some something which is not the iris. So, you can thresh hold it in such a way so that the part which is occluded, it will be 1 and the other one is 0. And then you find out how many are 1, and in this way you can say that it is 80 percent occluded, or something, 50 percent, 70 percent occluded, and things like that. So, in this way you can quantify and there are some, so once you start working on it, I can tell you several methods by which the things are being done, some codes are also there.

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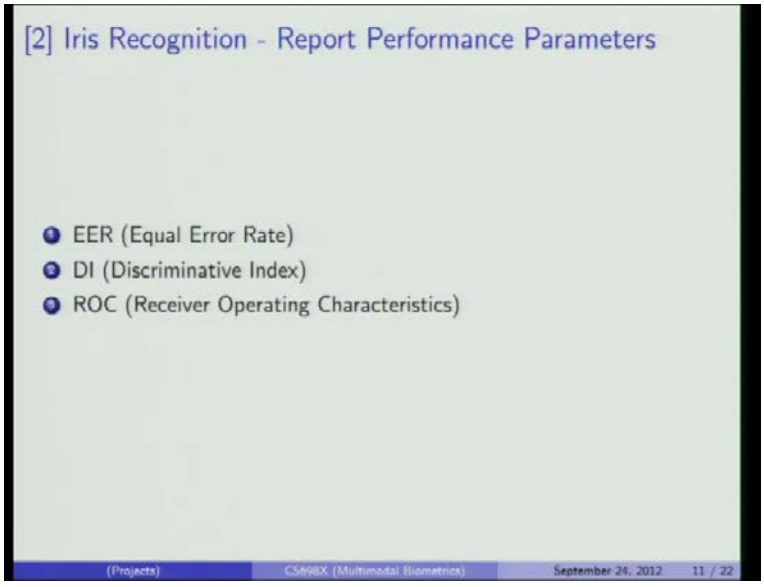

So, this is for the iris yeah. So, for the recognition, these are the three parameter that we used to think of, that is the equal error rate where the FAR is equal to the FfRR discriminative index and this is the ROC curve, basically the curve between the FAR and the FRR, these are the three things that we will be seeing.

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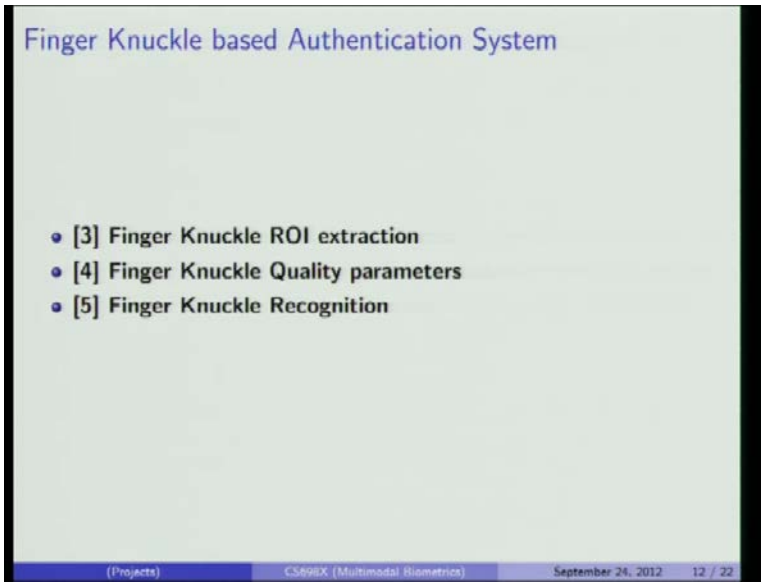

Now, starting with the, this knuckle print, this based knuckle based authentication system. So, in this also we will be having three things; extraction, and the quality parameters, and the recognition.

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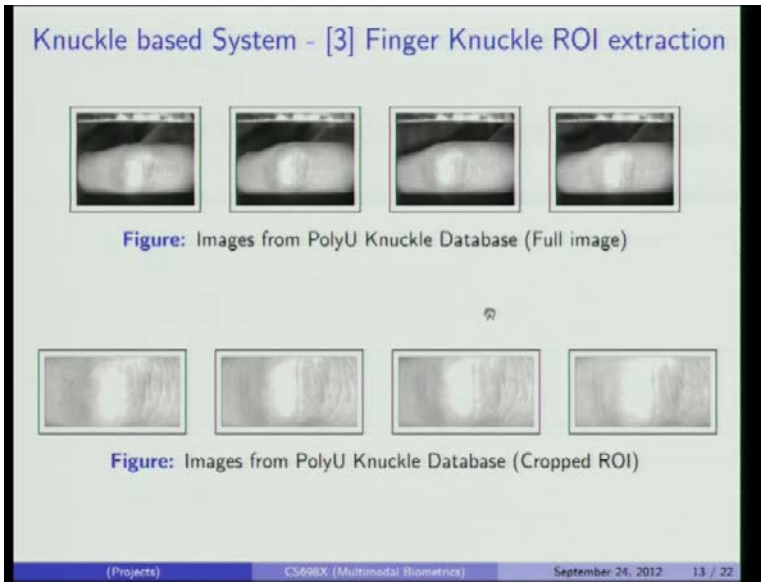

So, these are actually the images, so the polyU university, it is a Hong Kong university, there they have (()), they acquired these images, this is basically the outer part of the finger, they have a device by which they have captured, this is these are the images jpg, or jpg or bmp format. And this is, these are the images from the same subject, these are the full images.

Now, the first thing is the ROI extraction and this is very straightforward, this is the thing that we want, given this, it is a whole image. Now, what we want is that, only this much part from all of the images in synchronous way. I mean the part that you are going to collect from this image, I mean every time you will be getting the same part out of it.

Now, here you can see that, this this this and this are the corresponding ROI's that we have extracted from the from these images (Refer Slide Time: 18:12). This is the first problem that we wanted to, there is some; it is it is not a very difficult thing given algorithm, very simple algorithm you find out some edges over it. And then you can see that, here the things are some edges which will be convex and concave edges, and then you find out this a middle line, because it is not having that much concavity, and then using that you can divide it into two parts and then fix up an ROI, that is not a big thing.

So, this is one problem that out of this, we wanted automatically this thing and every time the same area, I mean if your algorithm is working from this, you are getting this and from this you are getting this (Refer Slide Time: 18:53). It should not be like this, from this you are getting this and from this you are getting some other portion (Refer Slide Time: 18:57). So, this is the the first problem, sir from here, sir it depends, because here this images are heavily illuminated in between the centre.

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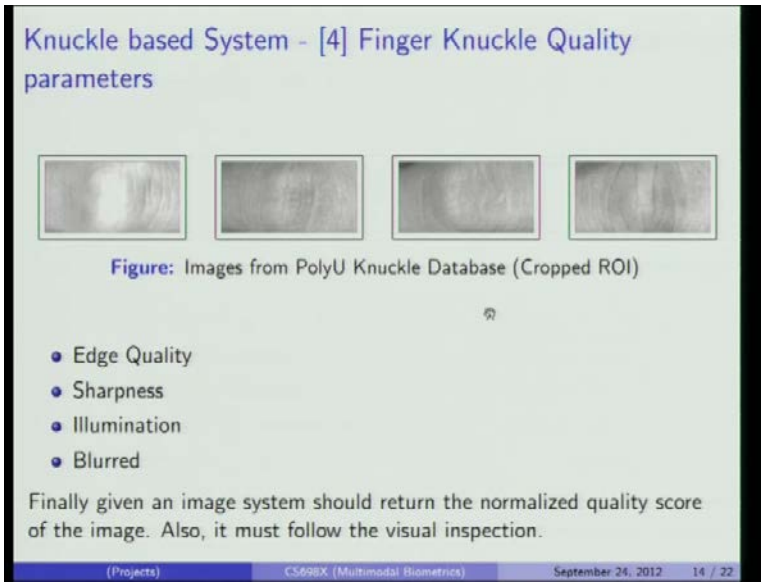

If I show some of the images that we have here, this is a first one, then here if you see because it is having some illumination problem, but it is not having that illumination problem.

So, here you can see that the the, it is having some texture over here also, because here the camera, the flash, whatever they have, it because of which it is heavily eliminated, here some of the features are lost over here. So, this is the second person's image and some third person and some fourth person, these are four different images of different subjects.

Now, if you see that the quality of the images changing in each of the image, now one can see that it is having illumination, it may not be having illumination. But one can clearly see that it is having good amount of texture within it, and everyone can say and everyone can say that, yes this is having this, it is better than this, or it is better than this, or vice versa, whatever.

So, how you are saying this thing and again the same thing is that you you have looked upon the edges, you have looked upon the brightness, you have looked upon the sharpness of the image. So, this is the thing that we again want, that the finger knuckle quality parameters, what is the the edges, out of the edges we see that how much they are connected and because of that, you can say that this is a good good edge, it is it is having a better edge structure than this one. And also as you know that the, if there is something

which is having some pattern it should not knuckles, it is having some some out of connectivity within it. It should not be something like that, suppose that you have here something, then here something, then here, it should be going very haphazard, it should not be very haphazard.

So, if you find out some connected component and as that, that is also being done over these things. So, those who will work on this may be may be thinking about the the edges and the quality of edges that you have, the sharpness of the image, the illumination, because as you can say that it will be poorly illuminated. One can say that it is having huge amount of illumination, because of which one can say that the quality of the image is not good and here you can say that the, it is properly illuminated.

Then, some of the images are having some blurriness in it, because of the motion or because of the sensor. So, these are some of the hints that I have written, some more things you can think of and you can add in it, these are very simple simple in mat lab if you find out these things, not more than 4, 5 lens, you can calculate these values, quantize it, and then you will be having the quality for this thing. Finally, again you should be returning the normalized quality score for for any given image and it also follows the visual inspection as I have shows I have said that if you are saying that the quality of this image is better than the other one, you should have to justify that why it is better, by looking also you can say this thing.

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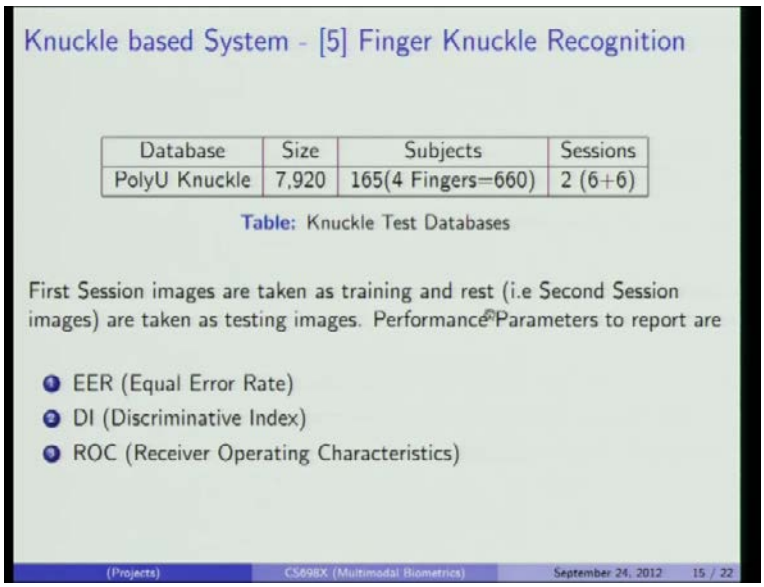

Next one is the finger knuckle recognition. So, the database, the same database I have told you, it is having something like 165 subjects; out of from this subjects 4 fingers are collected, something like 660 finger that they have collected and for they have collected data in two sessions 6 plus 6 something around, 8000 images are there in this database.

And the testing strategy again remains to be the same, that the first session images are matched with the second session images, and the performance parameters are again remains to be the same. So, if you are calculating I mean drawing the ROC curve that I can provide you that how you can draw the ROC curve that the simple script that you can be using.

So, given you a score a score file that you are generating, this is the ROC curve that you will be showing us later and the better ROC curve means that, suppose that if this is FAR and this is FRR. So, the the curve which is, if there there are two curves, so one can say that this curve is better and one curve represents a single system. So, if you are having two system, then you will be having 2 ROC curves and the curve which is lower, that system is better than the other system.

Exactly what it is, what it is new growth?

I will be going to

(())

No no no.

What are you going to do only the r y?

R y yes, only the r y and then they will come I I will understand I will just see the what they are thinking and then tell you that what are the different approaches, out of which you can select whatever you want to code, because you are working on mat lab.

Input is r y.

Input is r y and you will be returning input will be 2 r y's and you will be returning, so for recognition, and you will be returning a single score.

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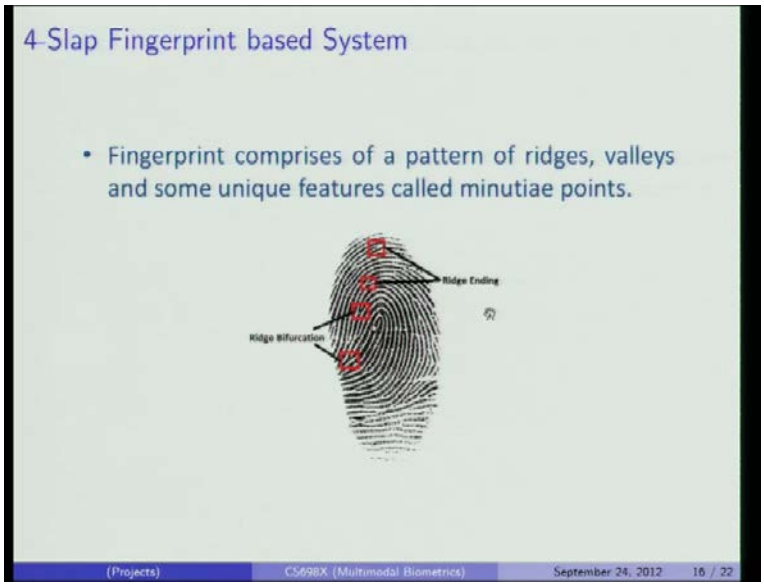

And the 4 slap, so yes, so there is a 4 slap's fingerprint based system. So, in this everyone knows that, this is a fingerprint, it is having ridges and valleys and because of which you will be having several minutiae points within it. So, there is several minutiae points that you can get, there will be several missing minutiaes, because of the improper minutiae extraction algorithm, then you will be having some spurious minutiaes also.

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But first, let just see what the 4 slap this fingerprint image is is. So, this is device that we have, using this if you can capture a fingerprint, this is like this and these are the four

different four different images of the same person taken once and it is a index middle ring and the little finger, they are acquired. And one can see straightforward that, once you have to put the pressure, so I have to press give a lot of pressure while giving your data and one can see that, if you just try to give more pressure, you will not be able to give much pressure on this little finger. So, straightforward you can see that, the quality of the little finger will be very bad and the recognition or the accuracy using only the little finger will be also very bad, because of the quality.

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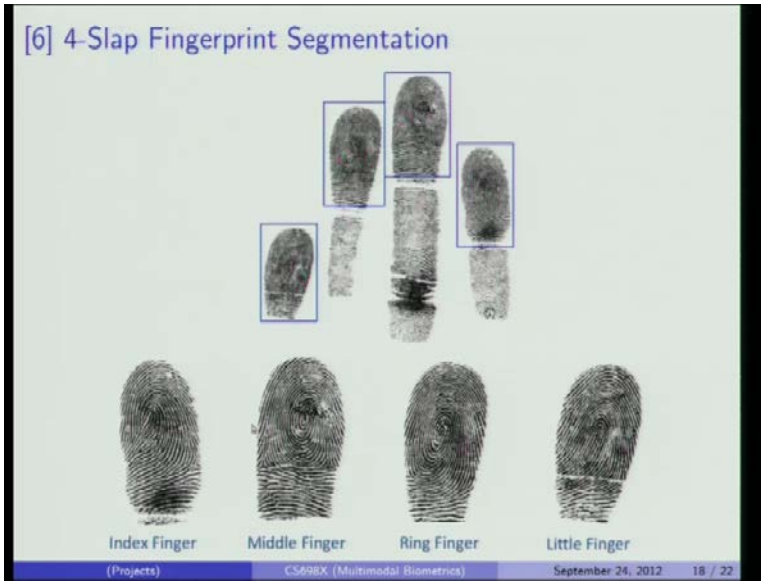

Yeah, so, this is the first problem. So, given this up to this, this is the image that will be giving you in a four single, four images within given image, and out of this you will have to extract this four images, 3 and 4.

Again you as you see that the background is white and these are black. So, this is a 0 1 image you can say, and very easily you can find out these blocks. The important thing is that where to crop, because you have to crop at the this knuckle line, the first knuckle line. So, that is also I think that, we want that given this first ever divided into, I mean divided into the region often cross, they had to be bond in then where you wanted to segmented, that is the knuckle line, calculate that knuckle line, efficiently and then crop from there.

So, every time you will be getting, whenever you are getting a finger print, you will be cropping it from here, not from here (Refer Slide Time 25:45). This is because of the

algorithms in accuracy; once you got the knuckle line, it will be cropping from here and every time you will look at in the same exact size of the ROI, it will be matching properly.

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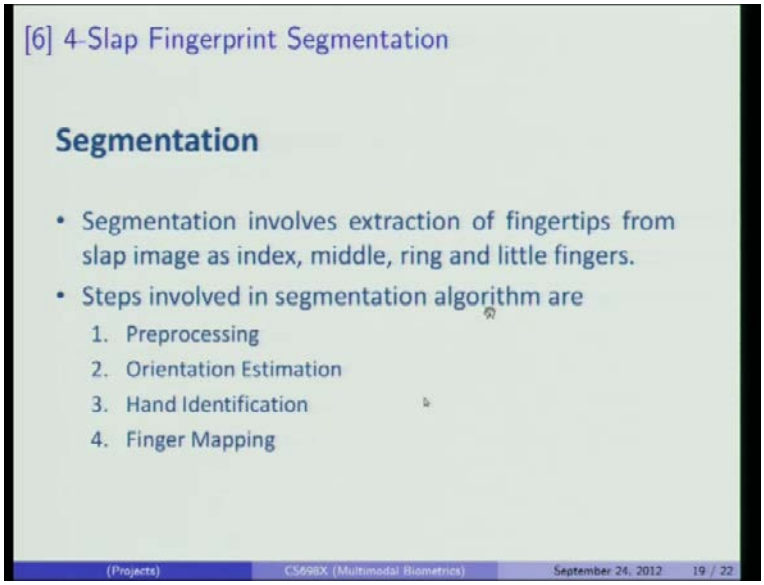

So, the segmentation, there are several steps, so first a preprocessing orientations. So, you find out the orientation, because sometimes what happen that given the fingerprint, you are giving in this way, sometimes you are giving a some different orientation. So, first of all you have to compute the orientation, then make it a vertical and then you divide it, also you have to identify the hand, because some most of the time what happened that, we use a particular protocol that first you will be giving the right hand data and then you will be giving the left hand data.

But what happened that, sometime it fails, I mean persons are coming giving the data and because huge amount of persons, they are they are they are giving the data, someone has given right, and someone has given left, change the order. So, what will happen that, the data that you are expecting of right hand, it is of the left hand. So, if we have a hand hand estimation algorithm that also, it is a very very simple thing, hand estimation one can see that, this finger is the bigger finger here, this a bigger to the left of it, it is a it is having 2 to the right of it 7, 2 something like this (Refer Slide Time 26:50).

So, it is also been done and then finger mapping. So, once you have got the four blocks, you will have to map it is a proper that a little finger, it is a middle finger or whatever.

So, it depends upon the hand, if it is right hand, then the the blocks that you have got, it will be mapped in a different way; if it is right hand, the blocks will be mapped in a different way.

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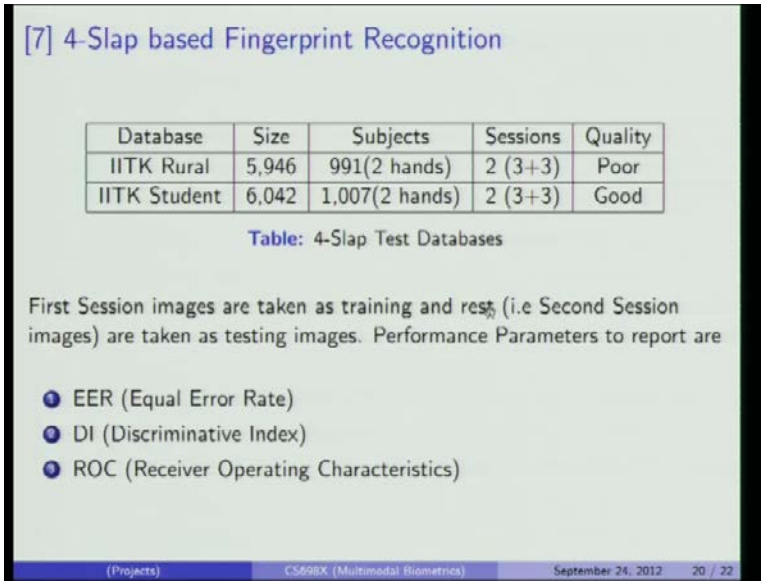

So, we have collected a huge amount of data for using this 4 slap scanner, the rural database that we have gone to village and we have collected huge amount of data, something like 6000 images out of say about 1000 subjects and it is a very typical data, you would not you would not get this data from anywhere. The thing is that, we have gone to village; they are the persons who are working, who are working in the farms, who are working doing some sort of labor things. So, what happen that, the the quality of the print that they have, most of the time is very fake.

Our high quality fingerprints scanners, they are failing over there to acquire their data, because the the print is so worn off, it is teared. I mean most of them are not having even the fingerprint, you know some of them are of 60 or even more than that age, and just they have came to give the data and what we have seen that, it is simply I mean that, the state of the art machine is not able to capture that data, somehow we have captured and the this 6000. So, these are very very hard, I mean you can say very difficult database, it is a very difficult database. On the other hand we have also our IITK student database or something like 1000 students 6000 images and this is a good quality, because here we do not, the all of the our fingerprints are very very good.

So, if if your work, so you will be working on both of this depending upon the accuracy. You can you can see that how bad this data, once you see this data, you can say that, oh yeah it is very very poor, then the IITK database. And the amount of, or the accuracies that the state of the art system use to claim, it is very very high. I mean it is something like, they will fail in say 10000 or 100000; in 100000 matching they will fail in one or two times. But if we if we use that algorithm, the state of the art machine algorithms and the scanners user and use this data, then you will see that it is failing quite regularly, it is very difficult.

So, these are the two database that you will be working on, again the first session. So, as I have told you the images are collected in two sessions 3 plus 3. So, first three images are often of first session, and rest of them are for the second session. So, first session images will be used as the training and the rest of the images are are used as a testing set and again these three things we used to calculate.

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And now about the security, he will be telling about the, I will be telling you something about the biometric security and the related issues. And actually, I am talking about the security at the security system itself, all of you know that we use biometric systems to secure some area, that if the person is authenticated well, then he can enter the system. But now we are talking about, what happens if somebody captures that system, how,

what can be the method so that we can save the system for not being captured by anybody.

There are actually two areas in the biometric security, the first area actually deals exactly what I am telling that, how the system should be protected, what are the technique to protect the system so that nobody can make fool of it, and make may replace the things and kind of things, I would explain more on this very soon. And the second thing is biometric crypto system, actually all of know the crypto cryptography says that, if I want to send some message from one place to another on a public system, so I have to encrypt that.

The encryption actually requires some key exchange kind of thing, I have a key, you have a key and we exchange that. But in the biometric system we know that, whenever we give our data in the second time that does not matches actually, if if I use my exact biometric information as a key, so it is not going to work. But then, we are trying to develop some systems which actually are resilient to the, to small changes, that actually the that are actually the properties of the biometric systems.

So, these are the actually two aspects on which I want to focus and I want to give some light on it, on that. The biometric template security actually says, you know about the templates actually, what is a template, actually when we for example, if somebody gives the fingerprint and at the some, at during the registration and after sometime, he again comes and give his the second impression and he want to get authenticated. We actually do not match the fingerprint as such, what we do, we extract the minutiae from the first impression and we also extract the minutiae from the second impression, and those two minutiae points are actually matched.

And there can be another methods, for example, we we cut out some circular regions and using those features, we are going to do the matchings. So, the matching is actually not done actually on the exact images, it is done on the template. So, that thing that minutiae is called a template, the set of minutiae is called the template, so we want to secure the template. Why we want to secure so that seeing, just seeing the template, persons should not be able to understand whose template it is.

If in a system, what I would do, I would place all the things into some directory or in some database structure I am, at the registration time, I would take the fingerprint images

of everybody, put in to the directory or put it in to some database. Then at later point of time, somebody want to attack, what he would do, he would just see the ID and he can replace the things. How can I make the system anonymous with the ID's, the first point is how can the one question is this, you can you can try thinking about that.

The second thing can be, if an anonymity has been done, think about that the system which have the, which is free from the ID names, then how how a person can see the things and can should not detect that whose biometric template it is. For example, I have many biometric templates, just by seeing the biometric template, person should not able to know whose biometric template it is. Because if he knows, then he can replace that biometric template with his own and then he can do the text kind of things.

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So, some of the techniques like for example, if I have if I have a biometric fingerprint, what I can do, I I can I can exchange the, I can do some permutation over the, I put this information over here and I I do some kind of permutation of these things. And using those permutation I create a new kind of things, new kind of map, I I create a kind of mapping over there and that is a permutation, and if I put this permutation into the database, just seeing that database, nobody would be able to figure out whose actually this impression is.

And when the second time person comes, I can use the same algorithm and go and in in the encryption domain, I can do the things well. So, there are some open issues over here

itself, we can think about developing the algorithm of for that and doing some testing over that so that we can be we can develop a better system.

In the biometric crypto system, the initial efforts started from the 2000 itself, where the people, what they did, they try to come up with some canonical biometric structures, what does it means, actually if I have an iris, I give my iris image once and if I second time I give my iris image, it was estimated that maximum 25 percent if the maximum. Generally 5 percent bits are different, from the first image to second image 5 percent images are, 5 percent bits are different and at a maximum 35 percent can go wrong with the second impression.

What I do, I can take 25 continuous photograph after some little duration from my, from a person's iris and then using some voting schemes on a particular bit on a particular bit, I apply a voting scheme, what is the bit which comes most, number of times, then using that information I can come of a some canonical structure that, this is the particular structure that should remain; if I take that 26 time, it is very near to that.

Then, what I can do, I can create some error correcting code for that, that is the given these 25 25 images, if this is the canonical structure, what should be the error correcting code which makes them very near, any any image coming any new image coming, I can apply that error correcting code to that, that because very near to this canonical structure. These kind of, actually techniques came up into the picture and another technique is biometric based fuzzy system which actually tries to develop some functions which are which are doing hashings over a local domain, local place domain so that they come of a some structure. So, these are some crypto graphical issues over there; if you are interested, you can try to come into this area and I can guide you on that.

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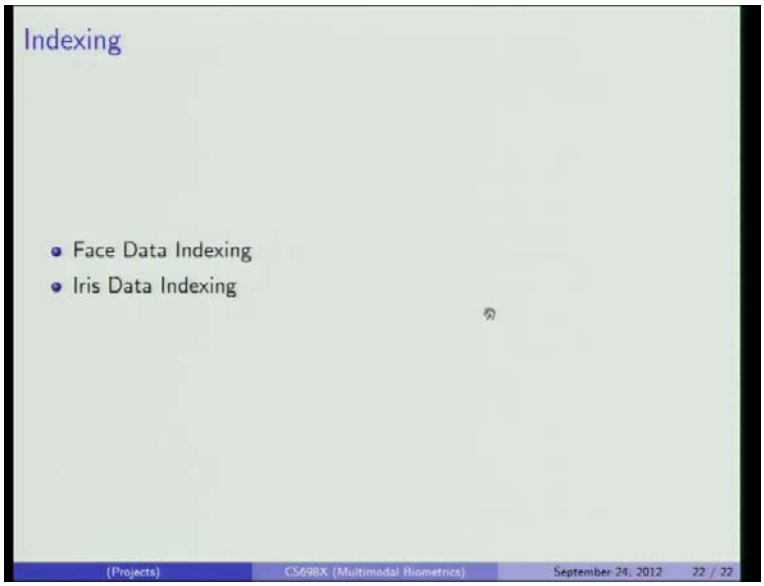

Next is the indexing, Uma madam will tell you.

So, in generally you have studied all basic things, performance of any biometric system special based on the accuracy and then how much error rate you have, so error in terms of false acceptance rate and false rejection rate. So, mainly any biometric system, how much error it is having, how much accuracy it is having, that is the two main performance, based on that you can say whether the system is performing good or bad.

Now, the problem in indexing is different, it is dealing with the scalability given some 1000000 record, actually we do not have or in terms of thousands, let us say a 7000 images, 8000 images, you want to how quickly you want to get the result without compromising the accuracy, that is the problem in it that you can see.

Actually, I do not want to give the full problem of indexing, because its takes a lots of time. I want some specific subset problem on face indexing. I have done a part of face indexing where initial part is missed that if you can, so the specific problem with this when you do the matching two images, if you do the registration, otherwise known as alignment. If you know the words alignment or registration, and even of it at the time of I mean at the time of enrollment, if the images are straight and at the time of recognition, if it is little bit translated or rotated, then it is very hard to match the two image features. So, what generally they do, they will do the alignment process, alignment or registration

with the availability feature; if you do not have the feature, then you cannot do the registration.

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What I observed is, in fingerprint there exist a point called the core point, that core point if you see it has I mean sometimes the structure it remains like this, this is known as left loop, because the ridge flows towards the left; and other these are the very popularly used structure, this is called the right loop, otherwise some arch pattern and there exist another arch pattern which normally does not applied. So, the specific problem, it is remembered to how to determine the, I mean this is a part of the ridge, we contain some other ridge row, we have to detect what is the core core point, I mean you have to detect that the it is a left loop or right loop.

Actually when you do the matching, before matching you just align based on this core point, then (()) not much difficult this is one problem, automate automatic, sir I will I will write automatic core point I mean, otherwise you can (()) as alignment, this is the subset, alignment you can do to core point or alignment you can do with the ridge (()) itself, actually if you do the alignment with the ridge (()) it is bit difficult problem, but you can think that.

Alignment, even an image straight and even an another image which is a little bit translated or rotated, how you can move that fingerprint fingerprint straight such that it it

will coincide with a image, this is known as alignment problem. So, this will help you to direct the matching easily, you want to add some more point?

Yes, that that move we have to core point detection algorithm.

Yes.

And there algorithm I have say acquisition 90 percent of

80 80 percent

80 percent. So, that algorithm if you want, we can give it you.

Yes.

And then then it vehicles that you can learn

You can improve, I mean we have automatically directed loop point, but it is performing on public database 80 percent result has come, and you can understand the core and you can improve that will help you. I mean this alignment problem is available in the literature, but we have not tried. If you want you give a try, you can do that also, I mean both are related for registration alignment before minutiae match.

Another one is, so in the face face database, I mean face database indexing also I have done. Now, as I said the registration, now here the core point is available. So, we are doing based on the core point, now in face I thought nose tip is available. So, let us think registration based on the nose tip and I have marked manually the nose tip and I have achieved some 90 percent result. Now, I want to find the automatic nose tip detection that is a straight problem, so given a face how to detect the nose tip automatically.

So, this is simple geometric operations only. So, you can find the two eye balls, that eye ball detection as existing in the literature and you can estimate the distance between the two eye ball, then vertical I mean draw a straight length that will passes through the nose, and you can find some distances from nose tips, I mean you have to study further so that you can detect that nose tip easily. So, this subset of that face indexing and if you want to interest, you can want to indexing as well, that is also available. I will write in this automatic noise point or noise tip detection and followed by indexing. If you have an

idea of indexing the whole image, this face databases, we can explore these things to specific problem.

We know of any all, any of this problems (()).

What is (())?

Fingerprint, you check on to your finger this finger and you see that that this type of line is there, here and this is your core points, now see this ridge line detection algorithm exist.

Yeah.

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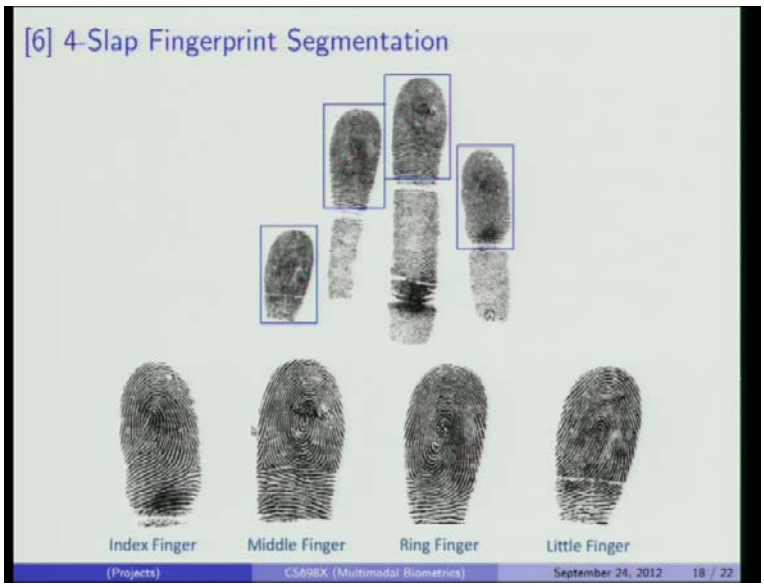

Although (()) exist, only thing is that using this algorithm you have to estimate, this is the probability here, this is the point.

You see this, the ultimately the peak point or the local loop heighest peak point and here this this is also that, that is known as right core and here it is, it no arch is available. I mean 90 percent of the fingerprint having left core or right core and remaining 5 percent only has other that we can.

Or or no no core.

No core.

Or or no core.

No core.

It is not guaranteed that you have done core, but see if I have the core point, if I can detect the core point automatically, then it can solve several cores, some of this that, see this is the registration part as she was telling right that you have to resist align where in other voice some put a figure may be up and some put a fingerprints is down, and mapping is some is a problem. But if I have the registration point, I register it, then I find out it is a coordinate correspondingly and match them distance at easily out.

So, manually core point we have detected, manually and we have seen the results and also we have doubt, we have result form a finding, it is not 100 percent accurate. So, this is one very challenging problem, you can do it very useful, and if you can show on our database whatever database I have, if you add manually we have obtained the core point. And if you can obtain, it is within certain data value and if you can show that one, I assured you that you will be very very good mark, right that is the thing, these are challenging problem and very good problem, interesting, it is not that it is not solvable, it is solvable, only thing little concentration is required.

Then this problem, face database nose point, geometrically you have to define, this eye centre point is known to you, it is given that it is you know if we take the inverse of your eye ball, then you it would become the white point straightway. So, you know the centre, these two centre is it would draw a line and if we dividing, then it will be like crossing through this white, this is a very geometrically you can define. Now, you know this point and then this point also you can find.

If you again divide it, that it is the centre lips you will be getting and they also this, the tells the distance between the central points and nose tip is also known to you, this is a define. If it is not defined from this point, if you draw a line from this part also, then there is a triangle you will get that triangle from that also, you can determine where is the nose tip?

These are only simple and supermatic technique you have to use to obtain. If I know this point again, same as we have I telling on the fingerprint face that, we can easily resister the two images and if I can register the two images, I can have the good indexing

technique. So, we are not going to give you the big problem, it give you only the small problem, that (()) problem what (()) is telling there is you you it is you have to little theoretical study am I right, and we also do not know how to do it. But it will be an important parameter, see one way is that I collect the image and then image has to be transmitted how safe is my image right.

I have taken newer fingerprints, now I am a franchisee, I I my job is to collect the, I do not have to do anything; I have to transfer to the head office. Now, that image if I transfer, then instead of your image, I can put my image and I can transfer right, in between some will be there and he changed your things and if says my image or your image instead of my image, so (()).

So, some thing some security has to be (()), this is one thing; then you have obtained the features from the fingerprints, how safe is my fingerprint features, let that is also another thing. So, there one method which is known as the cancel environment, we will observe it that also one can think that is it the only way or there exist some other way right.

Then the Aditya has given the quite a good number of problems, what big problem, here whatever he has told that fingerprint matching, then you need to get you need to get the minutiae points, now I feel that he he will be giving is a minutiae point, finally algorithm right. So, if you feel that, no sir, I want to design my minutiae point algorithm you can design, then that itself is a problem, but with the understanding that you will not be giving us the algorithm available no way that is, so that is not right, that is cheating basically that is cheating, you are that that would not expect from you, that is the first year, second year students they do.

So, what we want, that minutiae if you feel the sir, I want to obtain the minutiae point direction algorithm, find for us. If you are no sir, minutiae point algorithm, I am I am not interested, then he will give you the minutiae point, but you give us the quality parameters, what are the other issues you told matching (( )) right.

Then you know this as you known that, this four fingerprints are not equally good, some of them are very good quality some of different, the amount of pressure you have given based on that. So, this gives a very poor quality image, whereas this is a very good image, how do you know that, whether this is giving you the good result or not that is not

known. So, you have to test it and then you you have to put weightage on each finger, that weightage is required and then you fused the lens to obtain one matching score.

So, this is the thing, those when will be covering all those things in when you are regular class that, that will be easy for you to understand, but then the mean time you have to start your (()) that which project you are interested, and by what date you want, before by next week, is it? This will be kept on your, can you keep it on your, you will keep all these slides, you read it and just try to understand, then you know who is what they are seating in 109 and 106 right.

So, you can meet them, discuss, only these are that, do not come one after another, you will fix a time again and shake one slot right like that initially. After that once you select, anyway, because it is their interest, they also would spend that time, any doubt, no doubt? It cannot be either, there should be full of, a lot of doubts, otherwise you have not understood.